

Developing New Image Registration Techniques and 3D Displays for Neuroimaging and Neurosurgery
Yuese Zheng¹, Yici Jing¹, Thanh Nguyen², Sarah Zajac³, Jacob Wright³, and Robin Catania³

¹ Department of Electrical and Computer Engineering, Purdue School of Engineering and Technology;² Department of Computer and Information Science, Purdue School of Science;³ Department of Media Arts and Science, IU School of Informatics

Image guided surgery requires that the pre-operative data used for planning the surgery should be aligned with the patient during surgery. For this surgical application a fast, effective volume registration algorithm is needed. In addition, such an algorithm can also be used to develop surgical training presentations. This research extends existing methods and techniques to improve convergence and speed of execution. The aim is to find the most promising speed improvements while maintaining accuracy to best fit the neurosurgery application. In the recent phase, we focus on feature extraction and the time-accuracy trade-off. Medical image volumes acquired from MRI or CT medical imaging scans provided by the Indiana University School of Medicine were used as test image cases. Additional synthetic data with ground truth is developed by the Informatics students. The speed-enhancements to the registration are compared against the ground truth evaluated with mean squared error metrics. Algorithm execution time with and without speed improvement is measured on standard personal computer (PC) hardware. Additionally, the informatics students are developing a 3D movie that shows the surgical and preoperative data overlay, which presents the results of the speed improvements from the remaining students' work. Our testing indicates that an intelligent subset of the data points that are needed for registration should improve the speed significantly. Preliminary results show that even though image registration in real-time is a challenging task for real time neurosurgery applications, intelligent preprocessing provides a promising solution. Final results will be available at paper presentation.

Mentors: Lauren Christopher, Department of Electrical and Computer Engineering, Purdue School of Engineering and Technology, IUPUI; Mihan Tuceryan, Department of Computer and Information Science, Purdue School of Science, IUPUI; Albert William, Department of Media Arts and Science, IU School of Informatics, IUPUI